PITAC Review
NREN

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Agenda

- Application Highlights
- Network Testbed Highlights
- Research Collaboration
- Workshops
- Milestones

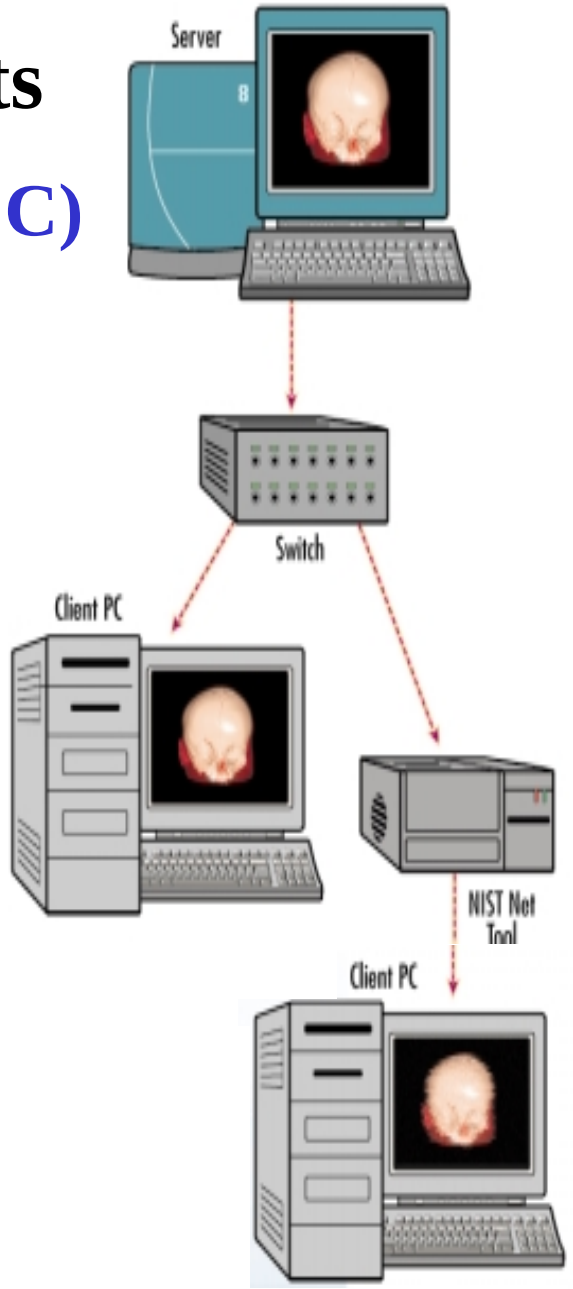
Application Highlights

- Virtual Collaborative Clinic
- Astrobiology
- Others:
  - Video Streaming
  - Over the Horizon
  - Intelligent Synthesis Environment
  - Digital Earth
  - Visible Human

Application Highlights

Virtual Collaborative Clinic (VCC)

- Goal: The Virtual Collaborative Clinic demonstrates a high performance testbed that allows colleagues in the medical arena to simultaneously view and manipulate 3-D medical images remotely in realtime.
- Network Requirements
  - Bandwidth: 30 Mbps - 50 Mbps
  - Multicast
- Partnerships:
  - Navajo Nation (New Mexico)
  - Abilene & vBNS
  - NASA Ames & NASA Glenn
  - CALREN2 GigaPOP
  - Stanford University & U.C. Santa Cruz



Application Highlights

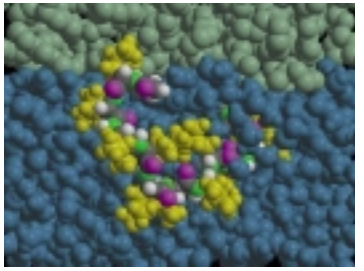
Astrobiology—Electron Microscopy

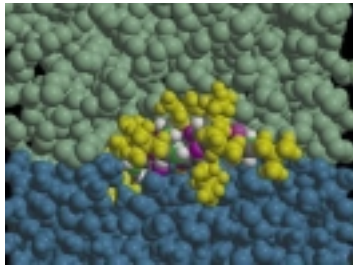
- Goal: To demonstrate the ability to conduct remote instrument science over the NGI
- Network Requirements
  - Connectivity among NASA and DOE labs during demonstration
  - Utilization of QoS for instrumentation command and control across congested networks
- Partners and Potential Partners:
  - NAI, DoE Oak Ridge National Labs, Oregon State University, NASA ARC

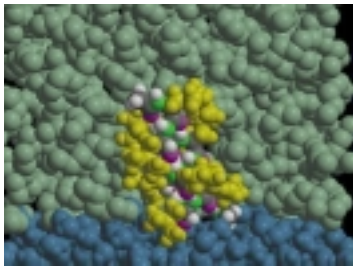
Application Highlights

Astrobiology—Molecular Modeling

- Goal: To demonstrate real time visualization and manipulation of data-intensive simulations in computational astrobiology.
- Network Requirements:
  - IP over ATM via NGI and Internet 2.
  - Quality of service (QoS) and bandwidth at levels high enough for real-time visualization (>500 Mbps anticipated).
- Partners and Potential Partners:
  - Ames, JPL, NTON







Application Highlights

Other Applications

- Video Streaming: Delivery of realtime broadcast quality video streams over a high performance IP network.
- Over the Horizon: Over The Horizon communications as a reliable solution to provide quick networking connectivity to areas with difficult accessibility.
- Intelligent Synthesis Environment: Development of a secure wide area set of application services.
- Digital Earth: An interagency framework and prototyping activity that seeks to provide a unifying, interoperable, user friendly interface to all US agency data and information about Planet Earth.
- Visible Human: Interactive access via TransPacific satellite to an NIH model that enables biomedical image segmentation, labeling, classification, and indexing using large images over NGI.

Network Testbed Highlights

PCMon

- Monitoring IP traffic subjected to preferential treatment
- Purpose:
  - Architect and deploy a QoS monitoring and measurement system at selected locations
  - Provide mechanism for long-duration measurements (hours and days)
  - General solution with applicability to QoS-based projects, such as the Astrobiology (Molecular Modeling)
- Activity Summary
  - Deployment locations: Chicago STARTAP, NASA Glenn Research Center
  - Basic validations complete: Remote access to monitors, NeTraMet packet capture, remote control/collection

Network Testbed Highlights

NGIX-SF

- Purpose: establish network interconnect point to allow for high-speed federally funded research networks to exchange traffic.
- Current Partners: DREN, NREN, NISN (all at OC-3) and Abilene (OC-12)
- Current Status: Operational; providing monthly network traffic statistics and documentation to the JET
- NREN at other NGIX Locations: Chicago (current) and Washington, DC (planned)

Network Testbed Highlights

Gigabit Networking

- Establish OC-48 Connections
  - NASA Ames, NASA GSFC, and JPL
  - Interconnection to NTON
  - Interconnection to ATDnet
- Applications
  - Digital Earth / Mars / Sky
  - Astrobiology - Molecular Modeling
- Workshop Planned in August 2000

Network Testbed Highlights

Quality of Service

- Goals
  - Provide guaranteed network resource reservation for NASA applications
    - Bandwidth
    - Latency
    - Error Rate
- Applications
  - Astrobiology - Molecular Modeling
  - Video Streaming
- Partners
  - Internet 2 QBone
  - Department of Energy

Network Testbed Highlights

Multicast Internet Exchange (MIX)

- First operational Multicast Internet eXchange located at NASA-Ames
- Currently 10 peering networks
  - 3 Federal
  - 7 commercial
- Protocols and Implementation
  - Native IP Multicast
  - Second Generation Protocols
- FY 2000 Goals: new switch installation, additional peering, Abilene connectivity

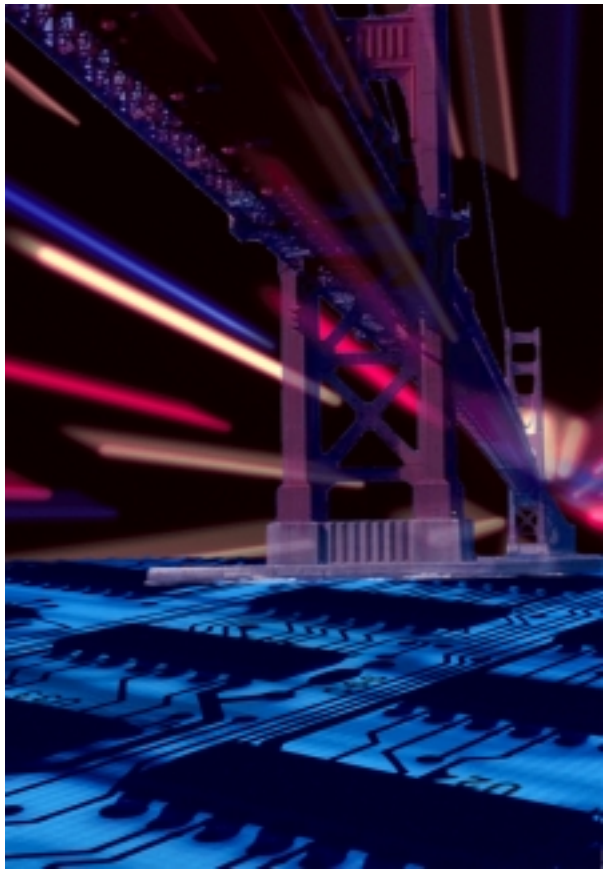
Research Collaboration

- University Grants:
  - Adaptive applications: NGI bandwidth and traffic management
  - Denial of service in the infrastructure
  - QoS problems in real-time VBR traffic in hybrid networks
  - Explanation and collaboration through concept maps
  - Efficient policy management using a SAAM server
- Partnerships:
  - QoS comparisons between satellite, microwave and T1 communications

Workshops

Bridging the Gap Workshop

- Held August 10-11, 1999, at NASA Ames Conference Center
- Cosponsored by NRT and HPNAT
- Attended by over 100 NGI technologists, applications, agency people
- URL: http://www.nren.nasa.gov/BTGreport



Workshops

"Gigabit Networking"

- LSN workshop planned for August 14-17, 1999; at NASA Ames Conference Center
- Will bring together over 100 NGI network researchers from government, academia, and industry
- Aimed at providing status, lessons learned, and creating consensus on how NGI network researchers should prototype and deploy real "gigabit-to-the-desktop" applications
- Three themes: Network, Desktop, Applications

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)			ORIGINAL NGI MILESTONES and Schedule		STATUS
1.4.1	Develop tools and techniques for quantitative measurement of communications quality of service.	**FY 2000 (4Q)**	Support the development and validation of hybrid communications architecture models; leverage activities performed under NREN and program	FY 1998 (1Q) FY 2000 (1Q)	Redirected to 5.2.1
1.1.1	Establish gigabit networking testbed for HPCC applications and testbed research.	**FY 2000 (4Q)**	Support testing for efficient, low bit error rate interfaces among terrestrial nodes, satellites, and mobile wireless networks	FY 1998 (1Q) FY 2000 (4Q)	Redirected to 5.2.1 (low bit error rate not addressed)
1.5.1	Adapt application codes for high performance test beds utilized for performance enhancements.	**FY 2001(4Q)**	Implement experimental OC-12 service at three sites	FY 1998 (3Q)	Redirected to 1.1.1
5.2.1	Demonstrate advanced networking tools and techniques on NASA-relevant missions applications utilizing Quality of service, multicasting, hybrid networks, and/or gigabit WAN capability.	**FY 2001(4Q)**	Implement next generation network management and monitoring for the NASA testbed	FY 1998 (3Q)	Redirected to 1.4.1
5.7.1	Demonstrate end-to-end networking capabilities utilizing gigabit to the desktop and traffic engineering demonstrations.	**FY 2001(4Q)**	Characterize QoS and analyze requirement of multimedia protocols (for example, MPEG-2 over ATM)	FY 1998 (3Q)	Redirected to 5.2.1
2.4.1	Develop tools to allow applications to automatically provision wide-area network resources using quality of service technologies.	**FY 2002 (3Q)**	Implement QoS parameters on five NASA testbed sites	FY 1998 (4Q)	Redirected to 3.2.1
3.2.1	Assure interoperability of quality of service, multicast and traffic engineering techniques across multiple networks.	**FY 2002 (4Q)**	Partner with sites that are experimenting with multigigabit networks in select laboratories, campuses, and regions to establish high speed networking research testbeds	FY 1998(4Q)	Redirected to 5.7.1

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)			ORIGINAL NGI MILESTONES and Schedule		STATUS
2.5.1	Application-embedded resource management for adaptive networking capability.	**FY 2003 (3Q)**	Demonstrate authentication (including PKI) for QoS, admission control, accounting/costing, etc.	FY 1999 (1Q)	Redirected to 2.5.1 (without accounting)
6.1.1	Establish impact on Earth and space sciences through the demonstration of a high-performance end-to-end network validated by NASA Enterprise observational mission data.	**FY 2003 (4Q)**	Provide integrated IP and ATM debugging, monitoring, and analysis tools	FY 1999 (2Q)	Redirected to 1.4.1
6.4.1	Establish impact on NASA's education missions through the demonstration of integrated adaptive networking tools and technologies.	**FY 2003 (4Q)**	Deploy ATM probe and servers for OC-3, OC-12, and up	FY 1999 (3Q)	Redirected to 1.4.1
8.4.1	Assess impact of NREN on aerospace, Earth and space sciences and education communities.	**FY 2005 (2Q)**	Implement resource reservation and real-time protocols on five NASA testbed sites	FY 1999 (4Q)	Redirected to 2.5.1
6.3.1	Establish impact on aerospace design and operations through the demonstration of integrated systems of applications, tools, services and resources which enable the high-performance execution of interoperable aerospace applications across distributed hete	**FY 2005 (4Q)**	Test network-to-network links at OC-48	FY 1999(4Q)	Redirected to 1.1.1
7.5.1	Provide technology transfer roadmap to NASA's operational WAN which will infuse quality of service, multicasting and traffic engineering into NASA operational wide-area networks.	**FY 2005 (4Q)**	Provide RSVP, admission control, analysis and debugging tools	FY 2000 (2Q)	Redirected to 5.7.1
			Determine (de)aggregation schemes across campus and WAN infrastructure (for example, SONET, WDM, and ATM)	FY 2000 (2Q)	Redirected to 5.7.1

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Implement 100+ Mbps LAN access to three NREN users	FY 2000 (2Q)	Redirected to 5.7.1
	Deliver gigabit-speed monitoring and analysis tools	FY 2000 (3Q)	Redirected to 1.4.1(independent of the gigabit-speed)
	Develop solutions for network monitoring and management tools for maintaining and measuring performance on NASA testbeds	FY 2000 (4Q)	Redirected to 1.4.1
	Develop multicast as a reliable service with acknowledged delivery and authentication. Demonstrate reliable multicast on five NASA testbeds	FY 2000 (4Q)	Redirected to 3.2.1(NREN does not provide service)
	Demonstrate with 100+ Mbps end-to-end communications over wireless and wireline networks	FY 2000 (4Q)	Redirected to 5.2.1
	Demonstrate network viewing and control capabilities for applications	FY 2001	Redirected to 2.4.1
	Demonstrate admission control/cost accounting, etc., for IP QoS	FY 2001 (2Q)	Redirected to 2.4.1(without accounting)

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Demonstrate guaranteed bandwidth and network availability on five sites across NASA testbeds	FY 2001 (3Q)	Redirected to 2.4.1
	Demonstrate remote network configuration and control at five sites across NASA testbeds	FY 2001 (3Q)	Redirected to 8.4.1
	Develop application performance benchmarks for gigabit and terabit testbeds.	FY 2001(1Q)	Redirected to 5.7.1 (no terabit focus)
	Demonstrate distributed network management and monitor tools across five NASA testbeds	FY 2002 (3Q)	Redirected to 1.4.1
	Provide at least 100+ Mbps to end users' desktops in a wide area environment by providing OC-48 (2.5 Gbps) service to support collaborative multimedia applications	FY 2002 (4Q)	Redirected to 1.1.1
	In partnership with industry and academia, develop performance measurements for OC-48	FY 2002(1Q)	Redirected to 1.4.1 (at the OC-12 level)
	Build a virtual NASA testbed through collaborative efforts of existing NASA centers	FY 1998 (1Q) FY 2000 (4Q)	Ongoing but no longer a milestone (actual connectivity is based desired research)

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Cooperate with international networks as appropriate to meet the needs of NASA partners and address NASA international connectivity requirements	FY 1998 (1Q) FY 2000 (4Q)	Ongoing but no longer a milestone (GOIN, CEOS, APAN 2000)
	Negotiate collaborative agreements with at least five industry partners	FY 1998(4Q)	Ongoing but removed as a milestone
	Establish R&D plans with industry partners on advanced network technologies in switching and routing	FY 1998(4Q)	Ongoing but removed as a milestone
	Demonstrate IP support for multimedia and real time audio and video across NASA testbeds	FY 1999 (2Q)	Ongoing but removed as a milestone
	Implement dual mode (network research and application network) across network	FY 1999 (2Q)	Ongoing but removed as a milestone
	Establish cross-agencies collaboration strategy and cost sharing agreements	FY 1999 (4Q)	Ongoing but removed as a milestone
	Demonstrate IP support for multimedia and real time audio and video across NGI	FY 2000 (3Q)	Ongoing but removed as a milestone

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Establish international high performance connections supporting application partnerships	FY 1998 (1Q) FY 1999 (4Q)	Compete (STARTAP)
	Demonstrate interconnection of NASA NGI infrastructure with other agency NGI networks (for example, NSF vBNS)	FY 1998 (2Q)	Compete (vBNS, ESNET, NISN, NTON, DREN, Abilene)
	Implement native multicast protocols on three NASA testbeds	FY 1998 (2Q)	Complete (GRC, JPL, ARC)
	Demonstrate interagency/intercarrier interconnection by means of agency equipment (IPv4)	FY 1998 (3Q)	Complete
	Interconnect NASA testbeds with at least two NGI Partners	FY 1998 (3Q)	Complete (NSF, DOE, DARPA, INTERNET 2)
	Upgrade NGIX to OC-12 capability	FY 1998 (4Q)	Complete
	Interconnect NASA testbed to five NASA scientific and research LANs	FY 1998 (4Q)	Complete

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Establish a system of high performance network interconnection points in partnership with industry and academia; provide for vendor neutral connection and access to high performance networks; provide direct access to very high speed experimental applicati	FY 1998(3Q)	Complete
	Upgrade select NGI users to end-to-end 10+ Mbps LAN access	FY 1998(4Q)	Complete
	Test and implement Constant Bit Rate Service	FY 1999 (1Q)	Complete
	Interconnect NASA to two other NGI networks at OC-12	FY 1999 (1Q)	Complete
	Test network-to-network links at OC-12	FY 1999 (4Q)	Complete
	Establish will-carry and peering arrangements with Federal research networking partners	FY 1999 (4Q)	Complete
	Establish peering arrangements at NGI Exchange Points	FY 1999 (4Q)	Complete

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Establish peering arrangements at GigaPOPs	FY 1999 (4Q)	Complete (in Chicago)
	Interconnect at least one NASA site and at least one university facility to ACTS	FY 1998 (1Q) FY 1999 (4Q)	Cancelled
	Pursue private sector satellite service partners to further technical achievements of ACTS program (esp. High Data Rate program—HDR).	FY 1998 (1Q) FY 2002 (4Q)	Cancelled
	Interconnect international WANs to NGI Exchange Points	FY 1998 (2Q) FY 2000 (4Q)	Cancelled (considered a LSN milestone)
	Develop standard simulation models to "grow" internetwork/intranetwork and develop baseline simulation statistics	FY 1998 (3Q)	Cancelled
	Develop plan with satellite community to collaborate on network service enhancements for achieving end-to-end seamless interoperability across high speed terrestrial/satellite network links	FY 1998 (3Q)	Cancelled
	Scope and design network of networks architecture and network management and control with Federal partners; everage partner investments to provide target OC-3 connection to sites using an interagency OC-12 backbone	FY 1998 (3Q)	Cancelled

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Test and implement Available Bit Rate Service	FY 1998 (4Q)	Cancelled
	Interconnect NASA networks with select broadband links to identify and evaluate network management and control, security, interoperability, and other technology issues	FY 1998 (4Q)	Cancelled
	Implement secure network technology across NASA testbed(s)	FY 1998 (4Q)	Cancelled
	Ensure minimum of three NASA sites at production OC-12	FY 1998 (4Q)	Cancelled (related to 7.5.1 efforts)
	Utilize requirement analysis and configuration management procedures to design and manage the NASA virtual testbed	FY 1999 (1Q)	Cancelled (unclear)
	Test and implement Switched Virtual Circuits for bandwidth on demand	FY 1999 (2Q)	Cancelled
	Develop distributed NOC and inter-NOC capabilities for NGI Goal 2.1	FY 1999 (2Q)	Cancelled (addressed by NASA's operations group, NISN)

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Develop cross-carrier interconnect and multi-institution peering management and analysis tools	FY 1999 (4Q)	Cancelled
	Demonstrate integrated cross-layer analysis and debugging tool	FY 1999 (4Q)	Cancelled
	Develop solutions for network security using encryption across NASA testbeds	FY 1999 (4Q)	Cancelled
	Partner with industry to test and develop aggregation/deaggregation techniques for OC-48 service	FY 1999(3Q)	Cancelled
	Demonstrate optical and fast switching networks; connect two NASA sites to the DARPA Broadband Information Technology testbeds	FY 1999(4Q)	Cancelled
	Scope and develop with industry the overall system cost, cost share, and collaboration to enable transfer of appropriate technologies	FY 1999(4Q)	Cancelled (addressed by NASA's operations group, NISN)
	Demonstrate interagency/intercarrier QoS support for ATM (NNI)	FY 2000 (1Q)	Cancelled

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Implement Layer-2 security technology at five NASA sites	FY 2000 (2Q)	Cancelled
	Demonstrate secure high speed and latency-bounded access to NASA on-line facilities	FY 2000 (3Q)	Cancelled
	Test network and transport protocols, encryption, and network management tools for high performance network	FY 2000 (4Q)	Cancelled
	Demonstrate NASA-wide certificate hierarchy and PKI that is interoperable with industry	FY 2000 (4Q)	Cancelled
	Implement IPv6 security technology at five NASA sites	FY 2000 (4Q)	Cancelled
	Demonstrate native deployment of IPv6 on NGI	FY 2000 (4Q)	Cancelled (new focus addressed in 5.7.1)
	Demonstrate application drilldown access to various network layer planes	FY 2000 (4Q)	Cancelled (unclear)

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Internetwork NASA testbeds with other Federal agency networks to create an interoperable interagency network of networks	FY 2000 (4Q)	Cancelled (unclear)
	Implement experimental OC-48 service at three sites	FY 2000(3Q)	Cancelled (NREN is non-operational)
	Direct intercarrier/interagency NGI ATM and IPv6 interconnection	FY 2001 (2Q)	Cancelled
	Demonstrate network reliability, QoS, scalability, bandwidth-sharing and integrated network services across NASA testbeds	FY 2001 (4Q)	Cancelled
	Implement network security technologies and policies across NASA testbeds	FY 2001 (4Q)	Cancelled
	Implement IPv6 security technology on NGI Exchanges	FY 2001 (4Q)	Cancelled
	Demonstrate interagency/intercarrier QoS support for RSVP	FY 2002 (2Q)	Cancelled

Milestones

CURRENT NREN MILESTONES (with HPCC milestone identifier and schedule)	ORIGINAL NGI MILESTONES and Schedule		STATUS
	Provide ATM QoS/NNI analysis and debugging tools	FY 2002 (3Q)	Cancelled
	Demonstrate admission control/cost accounting for ATM	FY 2002 (3Q)	Cancelled
	Demonstrate distributed management tools that cross multiple organization and vendor networks to meet agreed service levels and to ensure interoperability	FY 2002 (4Q)	Cancelled (addressed by NASA's operations group, NISN)
	Develop and implement interagency security policies	FY 2002 (4Q)	Cancelled (considered a LSN milestone)
	Connect two NASA sites at OC-48 and adapt applications and report performance	FY 2002(4Q)	Cancelled (addressed by NASA's operations group, NISN)
	Scope and design network of networks architecture and network management and control with Federal partners; leverage partner investments to provide target OC-12/48 connection to sites using OC-48/192 as an interagency backbone; develop aggregation/deaggre	FY 2002(4Q)	Cancelled (unclear)